Undergraduate Program in Biochemistry Website

11:115:404: General Biochemistry II

Offered

This is a lecture course which is offered each Fall, and Spring semesters. This course is the second semester of a two-semester integrated survey of biochemistry, the first half being General Biochemistry 403. The typically sequence is 403 in the Fall and 404 in the Spring, however, both courses are offered in the off semester.

Prerequisites and Registration Restrictions

Pre-requisites: 115:403,GRADE C OR BETTER.

Format

Two 80-minutes interactive lectures per week with asynchronous readings and assignments.

Description

This course is the second semester of a two-semester integrated survey of biochemistry. Biochemistry describes in molecular terms the structures, mechanisms, and chemical processes shared by all organisms and provides organizing principles that underlie life in all its diverse forms. Students will gain a fundamental understanding of what makes living systems tick at the molecular level. This includes a comprehensive survey of the chemistry of biological compounds, including proteins, polysaccharides, lipids, and nucleic acids, enzyme kinetics, bioenergetics, organelles, and cellular organization. Expression and processing of biological information, including DNA replication; transcription into RNA; translation into protein, regulation, and recombinant DNA techniques.

Topics covered

Week	Chapter
1	13 Introduction to Metabolism 14 Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway
2	14 Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway
3	15 The Metabolism of Glycogen in Animals
4	16 The Citric Acid Cycle

Exam 1: Chapter 13-16

5	17 Fatty Acid Catabolism
6	21 Lipid Biosynthesis
7	19 Oxidative Phosphorylation
8	19 Oxidative Phosphorylation

Exam 2: Chapter 17,21,19

9	20 Photosynthesis and Carbohydrate Synthesis in Plants
10	18 Amino Acid Oxidation and the Production of Urea
11	22 Biosynthesis of Amino Acids, Nucleotides, and Related Molecules
12	22 Biosynthesis of Amino Acids, Nucleotides, and Related Molecules
13	25 DNA Metabolism
14	26 RNA Metabolism

Exam 4: Chapter 20,18,22,25

15	27 Protein Metabolism
16	**Final**

Course Book

Lehninger Principles of Biochemistry, 8th Edition David L. Nelson - Michael M. Cox, with access to the Achieve Learning Platform.

Learning Goals

Upon successful completion of this two-semester sequence, students will using the language and reasoning of biochemistry be able to: (greyed sections are the focus of the second semester)

1. Relate the structure and function(s) of the following major classes of cellular components:
    a. Water
    b. Amino acids and proteins
    c. Sugars and polysaccharides
    d. Nucleotides and nucleic acids
    e. Fatty acids and lipids
    f. Membranes and membrane signaling proteins
2. Conceptually map biochemical core concepts:
    a. Levels of proteins structure, motifs, conformational changes, allosteric movements, folding/unfolding
    b. Receptor-ligand affinity
    c. Enzyme mechanisms and inhibition at the active site; substrate and transition state analogs, inhibitors
    d. Membrane chemistry and architecture; active and passive transport
3. Critically assess or Design an experiment using:
    a. Protein purification and analytical separation methods, including column chromatography, isoelectric focusing, and ultracentrifugation
    b. Protein sequencing and analysis, including MALDI and ESI mass spectrometry, Sanger's reagents, proteases, bioinformatics resources
    c. X-ray diffraction as an approach to atomic level structure/function; use of transition state analogs to pinpoint or modulate the active site
    d. FRET as used in high-throughput enzyme assays; FRET sensors
    e. Michaelis-Menten kinetics as an approach to understanding enzyme mechanisms, including the steady state approximation, kcat, Km, kcat/Km parameters;
4. Assess thermodynamic and entropic cost in biological processes
5. Diagram roles and deviations in enzyme-catalyzed reactions and reaction sequences in organism's physiology to:
    a. Obtaining chemical energy
    b. Converting nutrient molecules
    c. Polymerizing monomeric precursors in macromolecules
    d. Synthesizing and degrading biomolecules required for specialized functions.

6. Integrate structural components of DNA, RNA, and protein structure to the processes of DNA replication, transcription and translation.

Examinations

Three 80-minute exams and a three-hour final.

Syllabus

A specific and detailed syllabus will be available during the first class meeting and will be contained within the Learning Management System for that specific term.